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Do local public finances influence the economic growth of cities ?

The case of the 324 cities of the Tarn Department (France)

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Introduction

This paper aims at questioning the link between local finances and the economic dynamism of cities. This issue is based on the frequently stressed cases (by the media) of uncontrolled expenses of cities, increased level of local taxes and negative effects on local economics. This situation has been experimented in the cities of Briançon, Angoulême, and even in the little village of Eyne (Eastern Pyrenees) which had the biggest level of debt per inhabitant of the whole Europe in the beginning of the nineties.

For all that, it is not obvious that firms and households may really be able to "vote with their feet". For instance, there is no empirical evidence of the ability of households to punish any kind of drift in respect to Ricardo's equivalence which would be at their expense. Very few people can actually forecast a future raise of tax burden due to increasing debts, and strategically choose their location thanks to rational economic computation.

Therefore, as a starting point, the lack of neutral link between urban management and local attractive power of cities will be assumed. The relevance of the following assumptions will be considered :

* assumption n°1 : the choice of the financial way to manage a city would positively influence economic dynamism, provided it would express the agreement with a "budgetary orthodoxy convention" (Thomas 1999).

* assumption n°2 : conversely, local public management, insofar as it is based (notably) on debts and refers to what could be called a "keynesian convention" would negatively influence the attractive power of cities.

Thus, everything else equal, the more a city would be granted with important savings and internal cash flow, the more it could afford to finance it own investments (or increased investments with a given rate of self-financing), the less debt service would lessen the functioning resources of the following year, etc … Moreover, a healthy financial management would improve the probability of a city to attract households and firms : if debts and local tax burden can be restricted to a low level (in respect to the national average level, to the one of close competing cities …), then this low yearly increase of local taxes would not seem to shackle the dynamics of locations within a given city.

The empirical part of this paper deals with the test of the relevance of the previous assumptions. Our sample is composed with all the 324 cities of the French Department of Tarn. The specific features of this sample are : the important number of statistical observations, the fact that all the cities of a local level, between metropolitan areas and Regions, are considered, the diversity of environments (rural, urban, agriculture, industry, dynamic or depressed industrial sectors), high of low proximity with an European metropolitan area (Toulouse), …

The attractive power of Tarn cities will be estimated by the increase (or decrease) of population. The assumptions will be tested thanks to ordinary least square regressions. The database includes budgetary variables (budgets of cities, resources, expenses, savings, fiscal wealth, debts, investments, …), fiscal variables (local taxes, income tax, …) and also distances from each city to Toulouse, expressed in kilometres and in time. The conclusions will be detailed in terms of local planning, by comparing the impact of distance to fiscal "fixed" costs.

1 : Theoretical links between budgetary austerity and economic growth

1.1 : The main current trends of French local public finances

One of the main trends of current public funds, as to French cities, deals with the growing importance of self-financing, to the detriment of debts. First, a few definitions about savings must be stressed, by translating the notions of French public accountants. Management savings is the difference between operating resources and operating expenses (that is every kind of management costs, except interest). Gross savings is the difference between management savings and interest. Finally, net savings is the difference between gross savings and writing off of capital, or also the difference between management savings and annual repayment (DGCL 2003).

Thus, from 1997 to 2000, gross savings increased, since resources grew faster than operating expenses. The gross savings of French cities amounts to 8 billions euros, in spite of a slight decrease in 2001, due to a higher raise of public wages, and to the stabilization of debt service, after several consecutive years of decrease[1] (MINEFI 2003).

[1] -10,2% in 1998, -7,9% in 1999, -8,6% in 2000.

Insofar as public wages represent the main part of cities' operating expenses (almost 50% of operating expenses and nearly 33% of the global budget), it seems that the ability of cities to finance their investment expenses thanks to self financing merely depends on wages stalibilization. Thus, the more and more numerous transfers of competence and power from cities to metropolitan areas managed to lessen the ongoing growth of wages at the municipal level.

Broadly speaking, the unavoidable controlled rise of wages and the lower amount of debt service (4,7% of budgets in 2003) resulted in the appearance of important cash flows : more than 38% of investment resources in 2001, versus only 29% for debts (MINEFI 2003). Moreover, this increasing self-financing, since 1996, made it possible for annual repayment to be higher than new debts. Therefore, degearing is growing, and amounted to 30% of investment expenses in 2001.

Accordingly, one of the most noticeable features of French cities and local public organisations is their amazing situation of financial surplus, as to Maastricht point of view, and the huge decrease of debts (- 255 millions euros in 2001), as expressed by the 5.5 average years of repayment ratio (Klopfer 2002). As a matter of fact, as investment resources are higher than application of funds, the ensued cash flow enables this degearing, as well as an increase of net current assets. Consequently, the overall liquidity of French cities is appreciable, since this working capital stands for a safety margin, even if liquidity requirements are negative.

This specific and worthwhile situation resulted in a widely positive cash balance (9,1 billions euros in 2001, which represents an average value of 40 days of expenses). This high level can notably be explained by the risk aversion of little cities : their investment per inhabitant is more important than the one of bigger cities, whereas their precarious financial position often oblige them to save operating surplus during several years, before investing (MINEFI 2003).

1.2 : The arbitration between self-financing and debts

Thus, the last twenty years have been characterized by degearing, most of all since 1997. Debts of French cities have actually been cut down from 9.1% of GDP in 1987 to 7.6% in 2001 (Hoorens 2003). Several reasons may acquaint us with this strategy of degearing, of self-financing rather than debt. Some of them refer to current circumstances, like the rise in price of bank financing, because of the growing detightening of credit during the eighties. As a matter of fact, stopping reduced-rate loans of the C.D.C.[2], in an inflationary context, generated a dangerous rise of effective interest rates[3]. This rise dissuaded cities from new debts as well as keeping previous ones, insofar as these former loans have mainly been contracted with fixed rates, which could result in an explosion of debt service. (Guengant 2002). Referring to financial leverage, it was relevant to choose equity capital rather than long-term liabilities.

Nevertheless, this arbitration, which is in favour of self-financing, does not automatically imply a lower level of investment for French cities. Indeed, nearly 75% of French public investments are made at the local level. Cities' investments markedly increased from the eighties to the beginning of the nineties, which is not paradoxical at all. When the economic situation is dynamic enough to generate a rise of tax bases, a lower level of gearing may lessen debt service, and grant cities with increasing cash flows. This double stimulating effect for savings (rise of operating resources, and lower expenses) allowed a higher level of local investments. In such a specific context, financial orthodoxy, expressed by voluntarist degearing, started a virtuous circle of increased self-financing and investments. As mentioned by Sallez & Vérot (1993 p. 156), the cities with the heaviest burden of debt cause an outflow of investors, for their plans are retrained, which could prompt them to offer the lowest level of public services while increasing tax burden.

Conversely, the partial drastic cut in municipal cash flows[4], as shown by tax losses due to an economic downturn in the early 90', entailed an unprecedented stagnation of investments. The economic upturn at the end of the 90' and the decrease of effective interest rates were compulsory for the recovery in cash flows and self-financing rates.

[2] Caisse des Dépôts et Consignations (Deposit and Consignment Office)
[3] Formerly negative, because of low subsidized rates compared to a higher inflation.
[4] In this paper, we don't deal with the evolution of State criteria to grant cities with subsidies, which obviously have an influence on cash flows.

Thus, this analysis of the links between investments and cash flows stresses a radical contextual change : the end of a strict and perfect connection between loans and investments. Cities henceforth choose to invest only if they have sufficient cash flow, which means that the resort to debts becomes a residual resource, only when savings is not high enough. Therefore debts go up and down because of financial "good news" or "bad news", that is unexpected fiscal resources or expenses (Hoorens 2003).

In a political and institutional point of view, restricting gearing for local public entities is legitimated by Maastricht criteria. Let us remind that they apply to every kind of public entities (State, national health services and local administration). Thus, the French State cannot be accused of exporting its public deficit at the local level, by decentralising more and more tasks, since this strategy would not change the value of the deficit ratio (Guengant & Josselin 1999b). If we consider the chronic deficit of State and national health services, the careful management of French cities can hardly be challenged. As France and Germany currently don't care with their deficit ratio, the financial surplus of local public entities (cities, metropolitans areas, « départements », regions) hopefully does not widen the overall deficit of public administration. One may notice that the first models of local management during the sixties laid on the same kind of rigorous rules : the main goal was to maintain annual repayment under 20% of operating resources[5] (Bouinot 1999).

Moreover, even if the detightening of credit implied an easier resort to loans, we must remind that French cities are compelled to respect a constraint of budgetary balance[6]. As a matter of fact, any kind of upward drift is theoretically prohibited, since cities must have sufficient management savings in order to guarantee annual repayment. Consequently, debts can only finance investments (they cannot be used for operating expenses, in no way). The fear of negative budgetary consequences of the decentralisation prompted cities to degearing, in order to lessen debt service[7]. Thus, cities forecasted an ineluctable rise of operating costs and, at the same time, feared to be granted with additional insufficient subsidies. As a result, gearing is constrained by the ability of each city to generate sufficient cash flows. However, this ability may be restricted by uncontrolled costs (notably wages) or by a too large use of tax potential.

[5] The preliminary budgets of French cities in reveal an average value of 14%.
[6] As mentionned in the article L 1612-4 of the « Code Général des Collectivités Territoriales » (CGCT).
[7] The decrease of debt service is one of the main budgetary trend of the last decade : from 9.1 billions € in 1993 to 5.5 billions € in 2001.

Moreover, municipal cash flows first grew following the deindexation of wages to prices, whereas they shifted during the last three years, as the division of value added becomes again in favour of wages. In this context of lower management savings, the growth of gross savings merely depends on the lessening of debt service.

Finally, several psychological effects must be pointed out. They are linked to the appearance of the first cases of insolvency in a few French cities, like Angoulême. Their negative influence results from the unfortunate publicity that has been earned because of various above-the-line media, as they issued debt rankings. These new public tools enabled fast and easy inter-cities comparisons. They have naturally been integrated to the financial communication of virtuous cities, which induced a negative and "pathological" prejudice against indebted cities. Was it possible for local authorities, in such an environment, to be proud of a deliberate running into debt ?

All these reasons suggest that the current environment is in favour of financial orthodoxy and degearing, rather than a kind of « keynesian » policy based on indebtedness and public deficits. However, numerous contributions in the economic literature aim at challenging this idea. How can this opposite assumption be contended ?

1.3 : Which theoretical justifications for debt?

As a starting point, one could argue that the recovery of a positive leverage casts in a new light the question of arbitration between debt and taxes, in other words the balance between current and future local taxpayers. Thus, according to Klopfer (2002 page 76), we should run into debt if future surtax (so that annual repayment can be guaranteed) is inferior to the one currently needed if there is no additional debt. Therefore, it means that debt is a better solution whenever tax bases are dynamic enough. Nevertheless, two objections must be raised.

First, the lifeless economic situation and the development of various tax cuts[8] don't foresee any good coming from the dynamism of tax bases. Return on investments can hardly and scarcely be expected. Indeed, creating an industrial park is quite different from building a stadium, for instance. Accordingly, investments featured by low returns should rather be financed by equity capital, in order to protect oneself from higher rates. Indeed, these investments will generate few additional tax bases, whereas these latter would have been compulsory for annual repayment.

Secondly, it is not an obligation to question the dilemma "future taxes versus current debt ». Important cash flows can be made thanks to a rigorous and healthy management, and they may be high enough to finance new investments[9]. Thus we may emphasize that big cash flows don't imply the rise of tax burden, whereas interventionists often advocate this «implicit» idea.

One could object on the one hand that these virtuous circles concern only few cities, and on the other hand that local taxpayers would rather benefit immediately from such a good management, thanks to lower taxes (and then new debts). Local taxpayers (who are also electors) would fatally blame the strategy of maximizing cash flows. They would accuse local authorities of forecasting excessive tax burden, and induly collecting private incomes for public investment. Klopfer (2002 page 76), while advocating an "intelligent debt management", underlines the possibility for rational citizens, with perfect information, to invest cities' excessive savings on money market funds. However, it seems that such expectations and economic computation don't exist, since average citizens are unable to have rational expectations and even to understand the whole complexity of the imperfect information they are granted with. Besides, this solution is all the less relevant as local taxpayers used to consume fiscal grants instead of laying them aside.[10]

Therefore, degearing is not fatally linked to higher tax burden. Contrary to the idea stressed by Hoorens (2003 page 182), degearing does not entail any loss of room to manœuvre[11]. Finally, several authors argue that debts should be used to recover the perfect matching of new assets and new debts. However, this perfect symmetry between lives of assets and liabilities merely aims at improving the level of net current assets.

[8] Which reduces the financial autonomy of local authorities, as mentionned by Gilbert (2003).
[9] Like the city or Toulouse, where noticeable self financing and investments can be observed for many years, in spite of the stability of effective tax rates.
[10] Moreover this is the basic assumption of keynesian policies, which raises a new arbitration, between public and private consumption. But this problem goes beyond our paper.

Nevertheless, as previously pointed out, French cities have already accumulated substantial net current assets. Moreover, promoting cash flows amounts to increase internal resources, that is the level of net current assets.

On a theoretical point of view, cyclical and structural arguments seem to confirm the relevance of our initial assumption. The following empirical analysis intends to question this relevance more precisely, by using a statistical model for the cities included in the Tarn department.

2 : The case of the cities in the Tarn department

2.1 : Determination of sample and variables

The sample includes all the 324 cities of the Tarn department and can be featured by : an important number of statistical individuals, the exhaustive population at this spatial level, between metropolitan areas and Regions, with urban, peripheral, rural, industrial, agricultural environments, various sizes of cities (from 20 to 70000 inhabitants), different levels of proximity with the fourth French city (Toulouse), dynamic and declining industries, …

The economic appeal of Tarn cities will be considered in terms of population[12] (with logarithmic values), of increase in population, as well as gross professional tax bases[13]. Our assumptions will be tested with ordinary least squares regressions. Several kinds of variables will be entered in the models : budgetary variables (each part of preliminary budgets of cities, operating and investment expenses, resources, cash flows, savings, fiscal wealth, debts, …) fiscal variables (local taxes, income tax), distances from each city to Toulouse (expressed in kilometres and in time). We must underline that the value of each budgetary variable will be considered per inhabitant, in order to get rid of the influence of size[14]. We expect to confirm the two initial assumptions as well as the existence of a negative influence of the distance variable.

[11] The link between the variation of fiscal rates and gearing will be considered in the empiric part.
[12] Data are available for 1968, 1975, 1982, 1990 & 2001
[13] This is the common proxy variable for local GDP, with a two-years lag, even if this correlation is not anymore as high as it used to be (almost 99%), as underlined by Bouinot (1999). However, these tax bases won't be directly used in this paper, because they appear to be strongly correlated with population (98%).
[14] Thus whenever we talk about « outstanding debt », for instance, it means "outstanding debt per inhabitant » …. This applies to each budgetary variable.

The 48 variables of the sample include various indexes which have been previously emphasized by the economic literature about local finances, scoring, and even by the French law about local administration, called ATR[15] (for the ATR law compels cities to issue 11 ratios). These main variables are :

- operating expenses per inhabitant (ATR law, Taïrou 1999)
- operating resources per inhabitant (ATR law, Taïrou 1999)
- gross savings per inhabitant, as a proxy for cash flow (Guengant 1999)
- management savings / operating resources : index of performance (Serve 2002)
- local taxes per inhabitant (ATR law)
- fiscal resources / operating resources : ratio of financial autonomy (Serve 2002)
- local taxes / tax potential : room to manœuvre (Thomas 1999, ATR law)
- investment per inhabitant (ATR law)
- outstanding debt per inhabitant (ATR law, Capeci 1991)
- annual repayment per inhabitant (Thomas 1999, Sallez & Vérot 1993)
- outstanding debt / operating resources : debt ratio (ATR law, Serve 2002)
- debt service / operating resources : importance of debt (Serve 2002)
- wages per inhabitant : proxy for the size of cities and budgets
- wages / operating expenses (ATR law)
- investments / operating resources (ATR law)
- debt / gross savings : repayment ratio (Guengant & Josselin 1999a,)
- taxable income per inhabitant (Capeci 1991)
- gross savings/ investments : self-financing ratio (Taïrou 1999, Thomas 1999)
- bases and rates of land tax, poll tax and professional tax
- former increases in population : proxy for inertia (Thomas 1999)
- kilometre and time[16] distance to Toulouse (Thomas 1999)[17]
- connection to the A68 highway, between Albi and Toulouse (dummy variable)[18]

[15] Law n°125 in 1992. ATR stands for "Administration Territoriale de la République".
[16] Time distance has been computed by choosing, for each city, the « best » travel, that is to say the faster. An average speed of 60km/h has been used for «départementales" et "communales" roads, 90km/h for national roads and 130km/h for highways.
[17] Thomas (1999) refered to institutional rather than geographic distance. This distance was computed thanks to a vector distance of the productive structure of the 210 main French cities with the one of Paris.
[18] The value « 1 » is given to cities located closer than 10 to 12 kilometres away from a highway access. This interval takes the time distance to the highway access into account: less than10 km for the cities connected with a rather rural road, 12 km for faster travels).

Several initial statements can be emphasized, as to the correlations between variables. First of all, three sets of variables reveal noticeable internal correlations :

- variables about gearing, indebtedness, debt service, annual repayment, outstanding debt, repayment ratio. Insofar as a positive link between growth and degearing is expected, the analysis will select the variable of repayment.

- variables accounting for the amount of the budget, for a « size » influence (and correlated with size, even for their « per inhabitant » value) : sum of operating expenses, of operating resources, wages, debt service, local taxes, tax potential : wages will be selected because of their prevailing importance in budgets; local taxes (in percentage of resources) will also be integrated, as proxies for budgetary autonomy.

- variables standing for transportation costs and the role of distance : kilometre and time distance to Toulouse, connection to the A 68 highway : as the variable « connection A68 » appears to be significant, time distance will rather be considered

2.2 : Main results

In addition to this preliminary compulsory selection, several interesting correlations may be stressed, as they implicitly refer to the previous theoretical analysis. This correlation is :

- negative between time distance to Toulouse and connection to A68 (- 49.5%)
- negative between average taxable income and distance to Toulouse (- 42.9%)
- negative between investments and debt service (- 40.9%), annual repayment (-57.1%)…
- negative between net current assets and debt service (-28.6%), annual repayment (-27.8%), …
- positive between net current assets and investments (+ 16.4%)
- positive between investments and cash flows (+48.6%), …
- repayments are weekly linked to variations of fiscal rates (see note n°11) : +16% with professional tax rate versus – 4%[19] with poll tax rate.
- we confirm that investment per inhabitant is negatively linked to population (-5.2%)

[19] This value is not significant at the level 5%.

Thus, this first analysis accounts for trends which are consistent with our assumption of budgetary orthodoxy : investments and cash flows decrease when debt is higher, which illustrates current economic trends (Hoorens 2003). Repayments, as debt service will decrease, enable the existence of higher cash flows and/or higher investments. Besides, the economic growth of the Tarn cities seems to keep anchored in an environment merely featured by spatial inertia, as shown by the prevailing importance of the proximity to Toulouse.

The following models have confirmed our preliminary assumptions. Several equations have been computed, with different aggregates : logarithm of populations on the one hand (stocks) and variations in population on the other hand (flows). All of these equations respect the main basic assumptions of OLS : normal and homoscedastic residuals, lack of collinearity, of outliers, of autocorrelated errors ... The following tables sum up the main results.

Dependent variable : varpop82-01	***(1)*** **R^2 = 48.8%**	***(2)*** **R^2 = 48.9%**	***(3)*** **R^2 = 49.1%**
	non standardised coefficient B (standardised coefficients Bêta)		
Constant	-110.013	-26.209	-159.964
Variation population 1975-1982	0.852 (0.582)	0.864 (0.590)	0.856 (0.585)
Connection A 68	266.764 (0.341)	240.166 (0.307)	245.124 (0.325)
Average taxable income	9.855^{E}-3 (0.109)		8.748^{E}-3 (0.097)
Repayment	0.404 (0.068)		
Average poll tax base		0.195 (0.130)	0.139 (0.092)
Time distance Toulouse		-1.260 (-0.089)	

Dependent variable : lnpop01 R^2 **= 63.6%**	Non standardised coefficients		Standardised coefficients	T Student	Tolerance
	B	Standard error	Bêta		
Constant	4.523	0.209		21.648	
Wages	5.966^{E}-3	0.001	0.470	10.858	0.618
Local taxes % resources	3.381^{E}-2	0.004	0.338	8.707	0.768
Variation rate prof. tax	4.672^{E}-2	0.008	0.224	5.707	0.755
Time distance Toulouse	-9.415^{E}-3	0.003	-0.148	-3.349	0.594
Investment resources	-5.358^{E}-4	0.000	-0.151	-3.858	0.762
Repayment	3.175^{E}-3	0.001	0.119	3.128	0.797
Management savings % operating resources	8.749^{E}-3	0.003	0.095	2.610	0.877
Local taxes / tax potential	-4.235^{E}-3	0.002	-0.092	-2.280	0.707
Connection A 68	0.285	0.148	0.082	1.931	0.650

The model using population as a proxy for growth accounts for approximately 64% of the variability of this aggregate. Variables have been selected, in each model, by a stepwise method. All of them are significant at the error level of 5% (except 10% for one variable). Coefficients mainly confirm our initial assumptions. Thus, a negative linked can be observed between the dependent variable and three independent variables : the time distance to Toulouse, investments and the ratio between local taxes and tax potential. Consequently, the dissuasive influence of locations far away from Toulouse can be emphasized, as well as the too important recourse to local fiscal wealth, which reveals to lessening of budgetary degrees of freedom. As to investments, of course we don't contend that they shackle economic growth. The negative link merely confirms that little cities invest more per inhabitant than bigger cities.

On the opposite, population is positively linked to the other variables, that is to say connection to highway (better accessibility), savings ratio and repayments (budgetary orthodoxy), the share of local taxes in operating resources (budgetary autonomy of cities), as well as wages (standing for the structural effect of budgetary size of cities). It is interesting to notice that this latter variable has the highest standardised coefficient, and has been integrated in the first rank by stepwise method, since its link with population is the strongest. Thus, a foreseeable limit may be detailed : it is not surprising to stress a parallelism between the size of cities (even with logarithmic values) and budgets per inhabitant.

This key importance of inertia, which was the prevailing variable explaining the growth of the French biggest cities during the last two decades (Thomas 1999), is more clearly and less trivially expressed thanks to the three other equations (dependent variable : variations in population). These equations have an average R^2 of approximately 50%. All of them underline the determining influence of inertia. Thus, variations in population during the last twenty years merely reproduce the evolutions of the seven previous years.

This homogeneity is all the more noticeable that it is not specific to the main French cities, which used to illustrate the stability of the rank-size law, from century to century. This feature actually applies to various kinds of economic environments. Some of them have been weakened by the declining activities, which were strongly anchored (textile industries and mines, notably), some of them are composed with more dynamic activities (pharmacy, farm-produce industries…). Other places hardly bear an increasing enclosing, whereas cities located close to the highway (the first forty kilometres near Toulouse) are getting more and more included

in the large metropolitan area of Toulouse. Finally, a few cities have benefited from public decentralizations, like the universities[20].

Beyond this prevailing inertia, the positive impact of accessibility (negative sign for time distance and positive sign for highway connection), of restricted gearing (positive sign for repayments) can once more be emphasised. Moreover, inertia is also indirectly expressed by the two following variables, standing for a « wealth effect » : average taxable income and average poll tax base.

To sum up, variations in population would be all the stronger that they would reinforce previous agglomerative dynamics, that the connection to Toulouse would be easier, that the average fiscal wealth would be more important, and finally that local public management would refer to a convention of budgetary orthodoxy. Therefore, the analysis of the cities belonging to the Tarn department confirms our initial assumptions. However, one may wonder whether these results may also apply to :

* other samples at the same spatial level : what about the influence of variables which have not been taken into account, like notably the job functional structure ? Our results relating to the Tarn should be compared to other departments with similar (Tarn et Garonne) or different (Rhône) features.

* other aggregates standing for economic dynamism (jobs, skilled jobs, …) : are the results still the same ? Do debts and local taxes influence employment ? Do public policies differently influence firms and households ?

* other spatial levels, by dealing with more urban environments, with strategic relations within cities, with cities belonging to the same metropolitan area[21], or to very close metropolitan areas (Grand Toulouse versus Sicoval)[22] .

[20] Like the Champollion University, notably located in two cities in the Tarn (Albi and Castres).
[21] And sharing the same professional tax resources.
[22] «Grand Toulouse » includes Toulouse and cities at the northern, eastern and western part of the metropolitan area. “Sicoval” is another public entity, gathering various dynamic cities located in the southern part of the area of Toulouse.

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Annexes

Récapitulatif du modèle[j]

Modèle	R	R-deux	R-deux ajusté	Erreur standard de l'estimation	Changement dans les statistiques					Durbin-Watson
					Variation de R-deux	Variation de F	ddl 1	ddl 2	Modification de F signification	
1	,592[a]	,350	,348	,9698	,350	173,454	1	322	,000	
2	,697[b]	,485	,482	,8642	,135	84,482	1	321	,000	
3	,737[c]	,543	,539	,8157	,058	40,303	1	320	,000	
4	,768[d]	,590	,585	,7742	,047	36,253	1	319	,000	
5	,780[e]	,608	,602	,7582	,018	14,593	1	318	,000	
6	,786[f]	,618	,611	,7490	,011	8,873	1	317	,003	
7	,791[g]	,626	,618	,7428	,007	6,301	1	316	,013	
8	,795[h]	,631	,622	,7384	,006	4,763	1	315	,030	
9	,797[i]	,636	,625	,7353	,004	3,728	1	314	,054	1,943

a. Valeurs prédites : (constantes), Charges de personnel

b. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits

c. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP

d. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse

e. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse, total des emplois d'investissement

f. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse, total des emplois d'investissement, Remboursement d'emprunts

g. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse, total des emplois d'investissement, Remboursement d'emprunts, épargne de gestion en % des pdts de fonctionnement

h. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse, total des emplois d'investissement, Remboursement d'emprunts, épargne de gestion en % des pdts de fonctionnement, produit de la fisca directe / potentiel fiscal

i. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse, total des emplois d'investissement, Remboursement d'emprunts, épargne de gestion en % des pdts de fonctionnement, produit de la fisca directe / potentiel fiscal, connexion A68

j. Variable dépendante : ln population 2001

ANOVA[j]

Modèle		Somme des carrés	ddl	Carré moyen	F	Signification
1	Régression	163,139	1	163,139	173,454	,000[a]
	Résidu	302,852	322	,941		
	Total	465,991	323			
2	Régression	226,238	2	113,119	151,453	,000[b]
	Résidu	239,753	321	,747		
	Total	465,991	323			
3	Régression	253,057	3	84,352	126,765	,000[c]
	Résidu	212,934	320	,665		
	Total	465,991	323			
4	Régression	274,786	4	68,697	114,611	,000[d]
	Résidu	191,205	319	,599		
	Total	465,991	323			
5	Régression	283,176	5	56,635	98,515	,000[e]
	Résidu	182,815	318	,575		
	Total	465,991	323			
6	Régression	288,154	6	48,026	85,607	,000[f]
	Résidu	177,838	317	,561		
	Total	465,991	323			
7	Régression	291,630	7	41,661	75,504	,000[g]
	Résidu	174,361	316	,552		
	Total	465,991	323			
8	Régression	294,227	8	36,778	67,448	,000[h]
	Résidu	171,764	315	,545		
	Total	465,991	323			
9	Régression	296,243	9	32,916	60,888	,000[i]
	Résidu	169,749	314	,541		
	Total	465,991	323			

a. Valeurs prédites : (constantes), Charges de personnel

b. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits

c. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP

d. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse

e. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse, total des emplois d'investissement

f. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse, total des emplois d'investissement, Remboursement d'emprunts

g. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse, total des emplois d'investissement, Remboursement d'emprunts, épargne de gestion en % des pdts de fonctionnement

h. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse, total des emplois d'investissement, Remboursement d'emprunts, épargne de gestion en % des pdts de fonctionnement, produit de la fisca directe / potentiel fiscal

i. Valeurs prédites : (constantes), Charges de personnel, impôts locaux % produits, variation taux TP, temps toulouse, total des emplois d'investissement, Remboursement d'emprunts, épargne de gestion en % des pdts de fonctionnement, produit de la fisca directe / potentiel fiscal, connexion A68

j. Variable dépendante : ln population 2001

Coefficients[a]

Modèle		Coefficients non standardisés		Coefficients standardisés	t	Signification	Corrélations			Statistiques de colinéarité	
		B	Erreur standard	Bêta			Corrélation simple	Partielle	Partie	Tolérance	VIF
1	(constante)	4,938	,093		53,038	,000					
	Charges de personnel	7,505E-03	,001	,592	13,170	,000	,592	,592	,592	1,000	1,000
2	(constante)	3,972	,134		29,673	,000					
	Charges de personnel	6,076E-03	,001	,479	11,442	,000	,592	,538	,458	,914	1,094
	impôts locaux % produits	3,846E-02	,004	,385	9,191	,000	,525	,456	,368	,914	1,094
3	(constante)	3,927	,127		31,032	,000					
	Charges de personnel	4,813E-03	,001	,380	8,926	,000	,592	,446	,337	,790	1,266
	impôts locaux % produits	4,020E-02	,004	,402	10,154	,000	,525	,494	,384	,910	1,099
	variation taux TP	5,396E-02	,009	,258	6,348	,000	,415	,334	,240	,862	1,160
4	(constante)	4,689	,174		26,881	,000					
	Charges de personnel	5,591E-03	,001	,441	10,592	,000	,592	,510	,380	,743	1,347
	impôts locaux % produits	3,510E-02	,004	,351	9,115	,000	,525	,455	,327	,866	1,155
	variation taux TP	5,680E-02	,008	,272	7,028	,000	,415	,366	,252	,859	1,164
	temps toulouse	-1,45E-02	,002	-,228	-6,021	,000	-,138	-,319	-,216	,899	1,113
5	(constante)	4,752	,172		27,689	,000					
	Charges de personnel	5,962E-03	,001	,470	11,335	,000	,592	,536	,398	,717	1,394
	impôts locaux % produits	3,468E-02	,004	,347	9,191	,000	,525	,458	,323	,865	1,156
	variation taux TP	5,370E-02	,008	,257	6,750	,000	,415	,354	,237	,850	1,176
	temps toulouse	-1,23E-02	,002	-,194	-5,094	,000	-,138	-,275	-,179	,850	1,176
	total des emplois d'investissement	-5,06E-04	,000	-,142	-3,820	,000	-,097	-,209	-,134	,892	1,121
6	(constante)	4,755	,170		28,045	,000					
	Charges de personnel	5,536E-03	,001	,436	10,272	,000	,592	,500	,356	,667	1,500
	impôts locaux % produits	3,242E-02	,004	,324	8,521	,000	,525	,432	,296	,831	1,204
	variation taux TP	5,263E-02	,008	,252	6,689	,000	,415	,352	,232	,849	1,178
	temps toulouse	-1,22E-02	,002	-,192	-5,090	,000	-,138	-,275	-,177	,850	1,177
	total des emplois d'investissement	-5,56E-04	,000	-,156	-4,215	,000	-,097	-,230	-,146	,877	1,140
	Remboursement d'emprunts	3,068E-03	,001	,115	2,979	,003	,378	,165	,103	,804	1,244
7	(constante)	4,516	,193		23,363	,000					
	Charges de personnel	5,786E-03	,001	,456	10,642	,000	,592	,514	,366	,644	1,552
	impôts locaux % produits	3,344E-02	,004	,335	8,811	,000	,525	,444	,303	,821	1,218
	variation taux TP	5,439E-02	,008	,260	6,943	,000	,415	,364	,239	,842	1,188
	temps toulouse	-1,31E-02	,002	-,205	-5,443	,000	-,138	-,293	-,187	,832	1,202
	total des emplois d'investissement	-6,02E-04	,000	-,169	-4,559	,000	-,097	-,248	-,157	,860	1,163
	Remboursement d'emprunts	2,952E-03	,001	,111	2,887	,004	,378	,160	,099	,802	1,247
	épargne de gestion en % des pdts de fonctionnement	8,472E-03	,003	,092	2,510	,013	-,159	,140	,086	,883	1,132
8	(constante)	4,641	,201		23,139	,000					
	Charges de personnel	6,021E-03	,001	,475	10,925	,000	,592	,524	,374	,620	1,613
	impôts locaux % produits	3,506E-02	,004	,351	9,118	,000	,525	,457	,312	,790	1,265
	variation taux TP	5,023E-02	,008	,241	6,266	,000	,415	,333	,214	,794	1,259
	temps toulouse	-1,22E-02	,002	-,192	-5,060	,000	-,138	-,274	-,173	,811	1,233
	total des emplois d'investissement	-5,05E-04	,000	-,142	-3,646	,000	-,097	-,201	-,125	,772	1,295
	Remboursement d'emprunts	3,065E-03	,001	,115	3,012	,003	,378	,167	,103	,800	1,250
	épargne de gestion en % des pdts de fonctionnement	8,261E-03	,003	,090	2,461	,014	-,159	,137	,084	,882	1,133
	produit de la fisca directe / potentiel fiscal	-4,07E-03	,002	-,089	-2,182	,030	,035	-,122	-,075	,708	1,412
9	(constante)	4,523	,209		21,648	,000					
	Charges de personnel	5,966E-03	,001	,470	10,858	,000	,592	,522	,370	,618	1,618
	impôts locaux % produits	3,381E-02	,004	,338	8,707	,000	,525	,441	,297	,768	1,301
	variation taux TP	4,672E-02	,008	,224	5,707	,000	,415	,307	,194	,755	1,324
	temps toulouse	-9,42E-03	,003	-,148	-3,349	,001	-,138	-,186	-,114	,594	1,684
	total des emplois d'investissement	-5,36E-04	,000	-,151	-3,858	,000	-,097	-,213	-,131	,762	1,312
	Remboursement d'emprunts	3,175E-03	,001	,119	3,128	,002	,378	,174	,107	,797	1,254
	épargne de gestion en % des pdts de fonctionnement	8,749E-03	,003	,095	2,610	,009	-,159	,146	,089	,877	1,140
	produit de la fisca directe / potentiel fiscal	-4,23E-03	,002	-,092	-2,280	,023	,035	-,128	-,078	,707	1,415
	connexion A68	,285	,148	,082	1,931	,054	,308	,108	,066	,650	1,538

a. Variable dépendante : ln population 2001

Diagnostic des observations[a]

Numéro de l'observation	Résidu standardisé	ln population 2001	Prévision	Résidu
82	-3,526	5,63	8,2236	-2,5923
320	-6,397	4,25	8,9522	-4,7037

a. Variable dépendante : ln population 2001

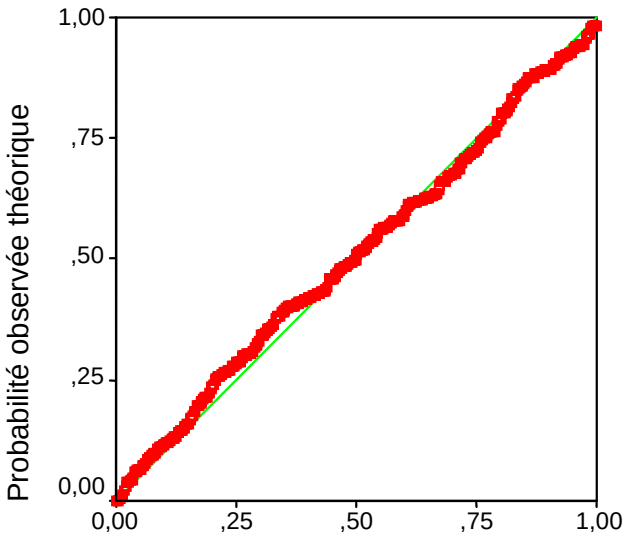
Statistiques des résidus[a]

	Minimum	Maximum	Moyenne	Ecart-type	N
Prévision	3,7087	9,8944	5,9379	,9577	324
Prévision standardisée	-2,328	4,131	,000	1,000	324
Erreur standard de prévision	5,654E-02	,4594	,1202	4,728E-02	324
Prévision corrigée	3,7350	9,7667	5,9438	,9625	324
Résidu	-4,7037	1,5908	-1,40E-15	,7249	324
Résidu standardisé	-6,397	2,164	,000	,986	324
Résidu studentisé	-6,854	2,221	-,004	1,013	324
Résidu supprimé	-5,3998	1,6757	-5,97E-03	,7673	324
Résidu supprimé studentisé	-7,421	2,235	-,006	1,028	324
Distance de Mahalanobis	,913	125,101	8,972	10,359	324
Distance de Cook	,000	,695	,006	,041	324
Bras de levier centré	,003	,387	,028	,032	324

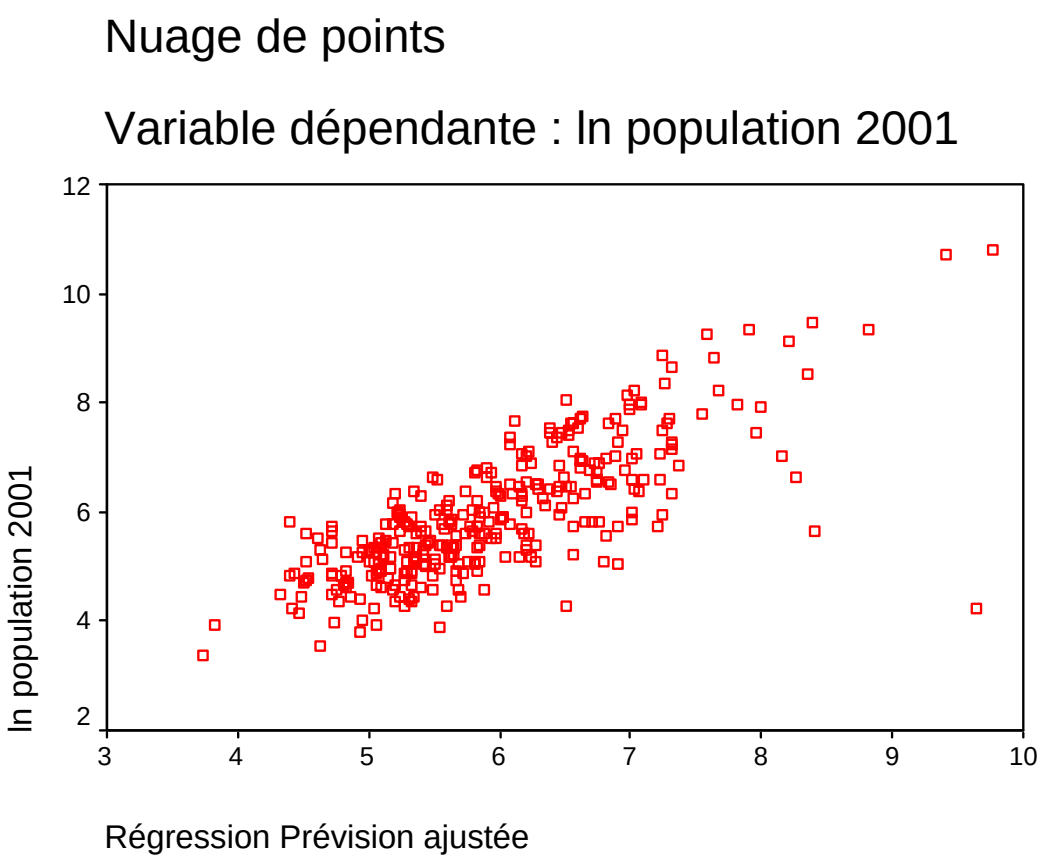
a. Variable dépendante : ln population 2001

Diagramme gaussien P-P de régression de Résidu standardisé

Variable dépendante: ln population 2001



Probabilité cumulée observée


Nuage de points
Variable dépendante : ln population 2001
ln population 2001
12
10
8
6
4
2
3
4
5
6
7
8
9
10
Régression Prévision ajustée